

Semantic web evolution

tectonic quake or gentle drift?

Jérôme Euzenat



November 19, 2016

Outline

The semantic web is a success
Why is evolution a problem?
Addressing evolution

The semantic web is a success Gloria allegro (ma no troppo)

Why is evolution a problem? Lamento andante

Addressing evolution Vivace moderato

Who am I

The semantic web is a success
Why is evolution a problem?
Addressing evolution

1992 Researcher at INRIA

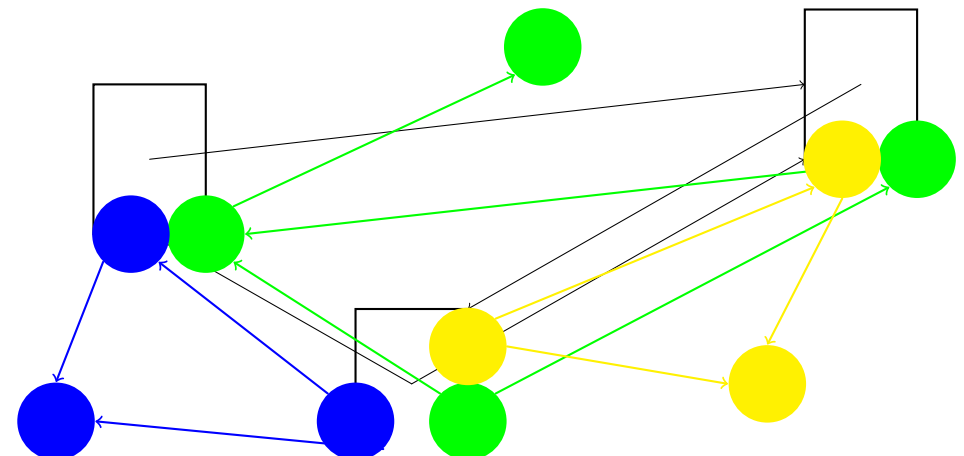
2000 Started creating the semantic web ;-)

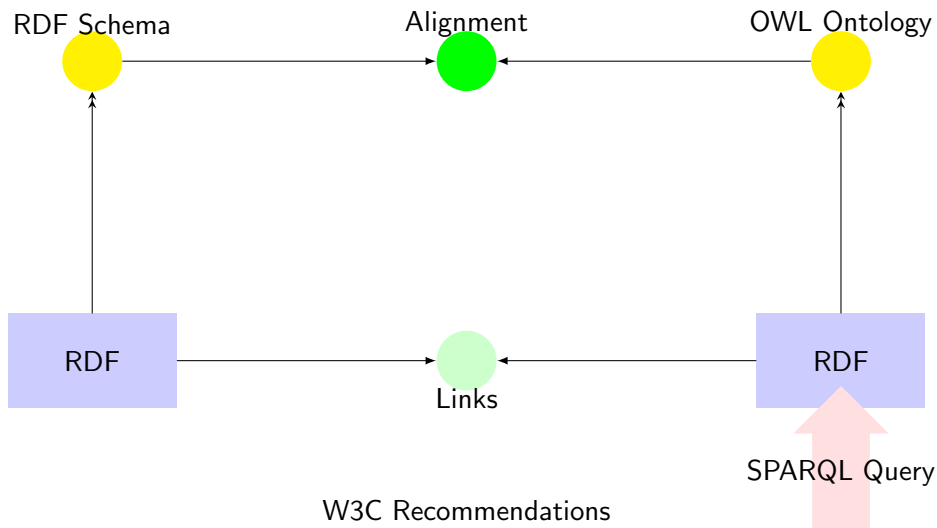
2012 Realised what we have done

2016 Fearing that it could break

Semantic web

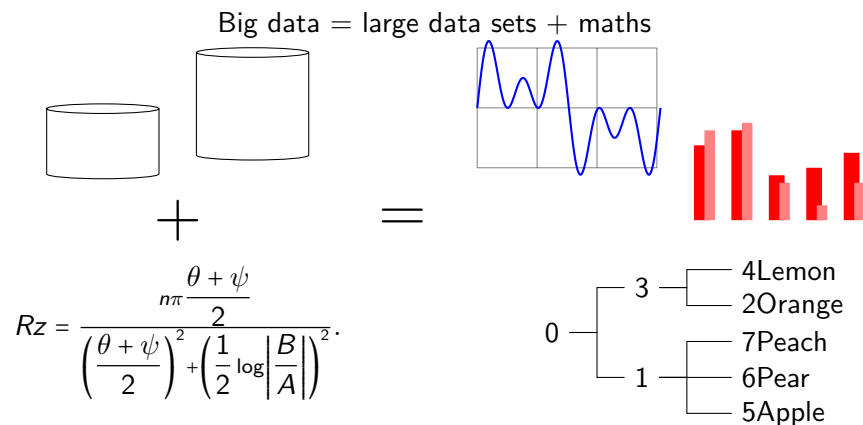
The semantic web is a success
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Application of semantic web technologies:

- ▶ *Semantic web services* in which web services are semantically annotated;
- ▶ *Semantic P2P systems* in which shared resources are semantically annotated;
- ▶ *Semantic social networks* in which social relationships are semantically annotated;
- ▶ *Ambient intelligence* in which sensors, devices and information are semantically annotated;
- ▶ *Linked data* in which data is published with semantic web technologies;
- ▶ *Smart cities* in which city data is exchanged would benefit in using semantic web technologies.



If this is not informed... the result will be: a plot!

Such technologies are used every day (by yourself).

- ▶ Tens of billions of RDF triples and thousands of ontologies on the web;
- ▶ Governments and their agencies publish their data in RDF;
- ▶ Facebook (OG), Google (GKG), Yahoo, Microsoft (schema.org) produce and consume semantic markup.
- ▶ And you do not even have to notice it.

Marie Curie's daughters

The semantic web is a success
Why is evolution a problem?
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Google

filles de marie curie

CONNEXION

Web

Images

Maps

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Plus

Outils de recherche


Environ 235 000 résultats (0,22 secondes)

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OK

En savoir plus

Marie Curie Filles



Irène Joliot-Curie



Ève Curie

Irène Joliot-Curie - Wikipédia

fr.wikipedia.org/wiki/Irène_Joliot-Curie

Elle est la fille de Pierre et Marie Curie. Épouse de Frédéric Joliot, elle a obtenu avec lui le prix Nobel de chimie en 1935 pour la découverte de la radioactivité ...

Biographie - Prix Irène Joliot-Curie - Notes et références - Voir aussi

Curie - Wikipédia

fr.wikipedia.org/wiki/Curie

Ève Curie (1904-2007), pianiste, écrivain (fille de Pierre et Marie). Irène Joliot-Curie (1897-1956), physicienne, prix Nobel de chimie en 1935 (fille de Pierre et ...

Patronyme - Unité de mesure - Institutions de la Rome antique

La petite-fille de Marie Curie reste engagée - Le Parisien

www.leparisien.fr/.../la-petite-fille-de-marie-curie-reste-engagee-19-05-2...

40 mai 2013 - À l'occasion de son anniversaire, la petite-fille de Marie Curie ...

Marie Curie

Physicien

Marie Curie, née Maria Salomea Skłodowska herb Dolega, le 7 novembre 1867 à Varsovie, au sein du Royaume du Congrès, et morte le 4 juillet 1934 au sanatorium de Sancellemoz situé à Passy, Haute-Savoie en ... Wikipédia

Naissance : 7 novembre 1867, Varsovie, Pologne

Décès : 4 juillet 1934, Passy


Découvertes : Radium, Polonium

Formation : Université de Paris (1903), Université de Paris (1894), Université de Paris (1891–1893)


Distinctions et récompenses : Prix Nobel de physique, Prix Nobel de chimie, Médaille Matteucci, Médaille Davy, Médaille John Scott

Enfants : Irène Joliot-Curie, Ève Curie


Recherches associées




Pierre Curie



Henri Becquerel



Albert Einstein



Ernest Rutherford

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Marie Curie's husband

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Environ 4 380 000 résultats (0,33 secondes)

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OK

En savoir plus

Pierre Curie (m. 1895–1906)

Marie Curie, Conjoint

Marie Curie - Wikipédia

fr.wikipedia.org/wiki/Marie_Curie

Pierre Curie — son époux — et Marie Curie reçoivent une moitié du prix Nobel Le 10 décembre 1903, Marie Curie reçoit avec son mari Pierre Curie et Henri ...

Pierre Curie - Discussion:Marie Curie - Catégorie:Marie Curie

Dates Marie Curie - L'Internaute

www.internaute.com > Dictionnaire

Marie Skłodowska épouse Pierre Curie Maria Skłodowska porte désormais le nom de Marie Curie. Elle avait rencontré son mari l'année précédente. Tous deux ...

Biographie Marie Curie - L'Internaute

www.internaute.com > Dictionnaire

Marie Curie reste une grande figure féminine du XXe siècle. ... Femme courage, la mort de Pierre Curie l'a poussée à poursuivre ses objectifs avec encore plus ...

Images correspondant à mari de marie curie

Signaler des images inappropriées

Pierre Curie

Physicien

Pierre Curie est un physicien français. Il est principalement connu pour ses travaux en radioactivité, en magnétisme et en piézoélectricité.

Wikipédia

Naissance : 15 mai 1859, Paris

Décès : 19 avril 1906, Paris


Conjoint : Marie Curie (m. 1895–1906)

Frères et sœurs : Jacques Curie


Découvertes : Radium, Polonium

Parents : Sophie-Claire Depouilly Curie, Eugène Curie


Recherches associées




Marie Curie



Henri Becquerel



Irène Joliot-Curie



Frédéric Joliot-Curie

Signaler un problème/Plus d'infos

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Pierre Curie's brother

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Outils de recherche

Environ 2 620 000 résultats (0,24 secondes)

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OK

En savoir plus

Jacques Curie

Pierre Curie, Frère

Pierre Curie - Wikipédia

fr.wikipedia.org/wiki/Pierre_Curie

Pierre Curie est le fils d'un médecin protestant, Eugène Curie (1827-1910) et de Sophie-Claire Depouilly (1832-1897). Il a un frère aîné, Jacques Curie ...



Jacques Curie - Wikipédia

fr.wikipedia.org/wiki/Jacques_Curie

L'œuvre majeure de Jacques Curie est la découverte de l'effet piézoélectrique avec son frère Pierre en 1880. Les deux frères sont alors préparateurs à la ...

Images correspondant à frère de pierre curie

curie - Signaler des images inappropriées



Jacques Curie

Physicien

Jacques Curie était un physicien français, professeur de minéralogie à l'université de Montpellier. Il est le frère de Pierre Curie avec qui il fait la première démonstration en 1880 de l'effet piézoélectrique. Wikipédia

Naissance : 29 octobre 1856, Paris

Décès : 19 février 1941, Montpellier

Frères et sœurs : Pierre Curie

Signaler un problème/Plus d'infos

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Marie Curie's brother-in-law

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Outils de recherche

Environ 411 000 résultats (0,32 secondes)

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OK

En savoir plus

Institut Curie - Wikipédia

fr.wikipedia.org/wiki/Institut_Curie

En 1934, peu de temps avant la mort de Marie Curie, sa fille, Irène Joliot-Curie, et son gendre, Frédéric Joliot, découvrent la radioactivité artificielle. En 1935, le ...

Marie Curie - Vikidia, l'encyclopédie des 8-13 ans

fr.vikidia.org/wiki/Marie_Curie

26 juin 2013 - Marie Curie » expliqué aux enfants par Vikidia, l'encyclopédie junior Quelques semaines avant sa mort, sa fille Irène et son gendre Frédéric ...

Select Live - Musées : Musee Curie

www.select-live.com/paris/fr/musees/description.php?m=musee_curie

Pendant près de 20 ans, Marie Curie poursuivit ces travaux dans ce laboratoire et c'est également dans ce lieu qu'Irène et Frédéric Joliot-Curie, fille et gendre ...

Fête de la Science : Marie Curie selon Pierre Radvanyi - L'Est Eclair

www.lest-eclair.fr/.../fete-de-la-science-marie-curie-selon-pierre-radvanyi

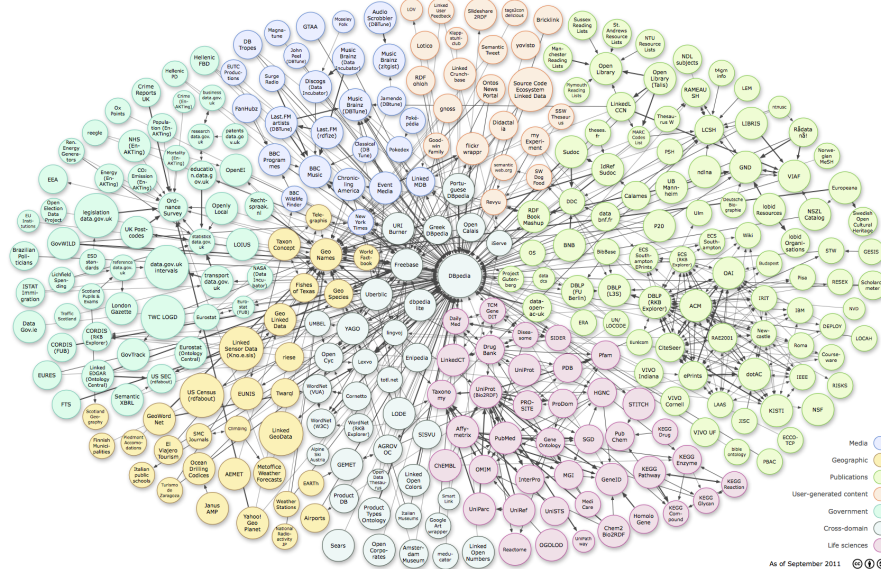
13 oct. 2011 - ... avec son épouse Irène Curie ; le gendre de Marie Curie, elle-même ... Il y a donc, de Pierre Radvanyi à Pierre Curie, Marie Curie et Henri ...

Donner recherche contre le cancer : Histoire de l'Institut Curie ...

curie.fr > Accueil > L'Institut Curie > Qui sommes-nous > Notre histoire

8 juin 2010 - Il servira à cette époque à Marie Curie qui dispense des cours à des infirmières en radiologie, les premiers du genre. Dès la fin de la guerre, ...

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I am a biologist
looking to compare various available insulin products on the market



Insulin Glargine [drugbank:DB00047] at Bio2RDF

<http://bio2rdf.org/drugbank:DB00047>

[Find intranamespace links](#) [Find global links](#) [Links Namespace](#) [Find links in namespace](#)

Subject	Predicate	Object
http://bio2rdf.org/drugbank:DB00047	http://bio2rdf.org/drugbank_resource:urlList	http://bio2rdf.org/html/drugbank:DB00047
	http://bio2rdf.org/drugbank_vocabulary:absorption	Forms microprecipitates following subcutaneous injection. Slow release of insulin glargine from microprecipitates provides a relatively constant concentration of insulin over 24 hours. Onset of action is approximately 1.1 hours.
	http://bio2rdf.org/drugbank_vocabulary:affected-organism	Humans and other mammals
	http://bio2rdf.org/drugbank_vocabulary:biotransformation	Partly metabolized to two active metabolites with similar <-in vitro<- activity to insulin: A21-Gly-insulin and A21-Gly-des-B30-Thr-insulin.
	http://bio2rdf.org/drugbank_vocabulary:brand	Lantus
	http://bio2rdf.org/drugbank_vocabulary:category	Approved
		Biotech
		Hypoglycemic Agents
	http://bio2rdf.org/drugbank_vocabulary:ddi-interactor-in	http://bio2rdf.org/drugbank_resource:DB00047_DB00052
		http://bio2rdf.org/drugbank_resource:DB00047_DB00187
		http://bio2rdf.org/drugbank_resource:DB00047_DB00195
		http://bio2rdf.org/drugbank_resource:DB00047_DB00264
		http://bio2rdf.org/drugbank_resource:DB00047_DB00335
		http://bio2rdf.org/drugbank_resource:DB00047_DB00373
		http://bio2rdf.org/drugbank_resource:DB00047_DB00489
		http://bio2rdf.org/drugbank_resource:DB00047_DB00521

Drugbank in Bio2RDF (cont'ed)

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Why is evolution a problem?
Addressing evolution

<p>http://bio2rdf.org/drugbank_vocabulary:pharmacology</p>	<p>http://bio2rf.org/vsapiant:7476652</p> <p>Insulin is a natural hormone produced by beta cells of the pancreas. In non-diabetic individuals, a basal level of insulin is supplemented with insulin spikes following meals. Increased insulin secretion following meals is responsible for the metabolic changes that occur as the body transitions from a postabsorptive to absorptive state. Insulin promotes cellular uptake of glucose, particularly in muscle and adipose tissues, promotes energy storage via glycogenesis, opposes catabolism of energy stores, increases DNA replication and protein synthesis by stimulating amino acid uptake by liver, muscle and adipose tissue, and modifies the activity of numerous enzymes involved in glycogen synthesis and glycolysis. Insulin also promotes growth and is required for the actions of growth hormone (e.g. protein synthesis, cell division, DNA synthesis). Insulin glargine is a long-acting insulin analogue with a flat and predictable action profile. It is used to mimic the basal levels of insulin in diabetic individuals. The onset of action of insulin glargine is approximately 90 minutes and its duration of action is up to 24 hours.</p>
<p>http://bio2rdf.org/drugbank_vocabulary:product</p>	<p>http://bio2rdf.org/drugbank_resource:0f81aa6a381c43d34e92b1c20e21f482</p> <p>http://bio2rdf.org/drugbank_resource:4e6109c89e08e86f3e21c14e174e109d</p> <p>http://bio2rdf.org/drugbank_resource:562b89336f9ac1c47f39c097933706809</p> <p>http://bio2rdf.org/drugbank_resource:8303abbfbfe1021e6ec0094de5677fe</p> <p>http://bio2rdf.org/drugbank_resource:f42f4d5a1107a24067e6729821b36d</p>
<p>http://bio2rdf.org/drugbank_vocabulary:synonym</p> <p>http://bio2rdf.org/drugbank_vocabulary:target</p>	<p>Insulin Glargine (rDNA origin)</p> <p>http://bio2rdf.org/drugbank_target:36</p> <p>http://bio2rdf.org/drugbank_target:958</p>
<p>http://bio2rdf.org/drugbank_vocabulary:toxicity</p>	<p>Inappropriately high dosages relative to food intake and/or energy expenditure may result in severe and sometimes prolonged and life-threatening hypoglycemia. Neurogenic (autonomic) signs and symptoms of hypoglycemia include trembling, palpitations, sweating, anxiety, hunger, nausea and tingling. Neuroglycopenic signs and symptoms of hypoglycemia include difficulty concentrating, lethargy/weakness, confusion, drowsiness, vision changes, difficulty speaking, headache, and dizziness. Mild hypoglycemia is characterized by the presence of autonomic symptoms. Moderate hypoglycemia is characterized by the presence of autonomic and neuroglycopenic symptoms. Individuals may become unconscious in severe cases of hypoglycemia. Other adverse events that may occur include allergic reaction, injection site reaction, lipodystrophy, pruritis, and rash.</p> <p>http://bio2rdf.org/ahfs:88-20-08</p> <p>http://bio2rdf.org/atc:A10AE04</p>

Drugbank in Bio2RDF (receptor)

- The semantic web is a success
- Why is evolution a problem?
- Addressing evolution

Insulin receptor [drugbank_target:36] at Bio2RDF

[Find intranamespace links](#) [Find global links](#)

Links Namespace Find links in namespace

http://bio2rdf.org/drugbank_target:36

Insulin receptor [drugbank_target:36]

Subject	Predicate	Object
http://bio2rdf.org/drugbank_target:36	http://bio2rdf.org/drugbank_vocabulary:article	http://bio2rdf.org/pubmed:10443650
		http://bio2rdf.org/pubmed:10733238
		http://bio2rdf.org/pubmed:11260230
		http://bio2rdf.org/pubmed:11374898
		http://bio2rdf.org/pubmed:12023989
		http://bio2rdf.org/pubmed:12107746
		http://bio2rdf.org/pubmed:12538626
		http://bio2rdf.org/pubmed:1321605
		http://bio2rdf.org/pubmed:1470163
		http://bio2rdf.org/pubmed:1472036
		http://bio2rdf.org/pubmed:1563582
		http://bio2rdf.org/pubmed:1607067
		http://bio2rdf.org/pubmed:1607076
		http://bio2rdf.org/pubmed:1730625
		http://bio2rdf.org/pubmed:1890161
		http://bio2rdf.org/pubmed:1963473
		http://bio2rdf.org/pubmed:2002058
		http://bio2rdf.org/pubmed:2040394
		http://bio2rdf.org/pubmed:2121734
		http://bio2rdf.org/pubmed:2168397
		http://bio2rdf.org/pubmed:2210055
		http://bio2rdf.org/pubmed:2211730

Drugbank in Bio2RDF (cont'ed)

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/drugbank_vocabulary.signals	
/drugbank_vocabulary:species	http://bio2rdf.org/taxon.9606
/drugbank_vocabulary:specific-function	This receptor binds insulin and has a tyrosine-protein kinase activity. Isoform Short has a higher affinity for insulin. Mediates the metabolic functions of insulin. Binding to insulin stimulates association of the receptor with downstream mediators including IRS1 and phosphatidylinositol 3'-kinase (PI3K). Can activate PI3K either directly by binding to the p85 regulatory subunit, or indirectly via IRS1
/drugbank_vocabulary:synonym	CD220 antigen
	EC 2.7.10.1
	IR
	Insulin receptor precursor
/drugbank_vocabulary:theoretical-pi	6.18
/drugbank_vocabulary:transmembrane-regions	957-979
/drugbank_vocabulary:xref	http://bio2rdf.org/genatlas:INSR
	http://bio2rdf.org/genbank.307070
	http://bio2rdf.org/genbank.M10051
	http://bio2rdf.org/genecards:INSR
	http://bio2rdf.org/hgnc.6091
	http://bio2rdf.org/hprd.00975
	http://bio2rdf.org/ptfam:PF00041
	http://bio2rdf.org/ptfam:PF00757
	http://bio2rdf.org/ptfam:PF01030
	http://bio2rdf.org/ptfam:PF07714
	http://bio2rdf.org/uniprot.P06213
http://purl.org/dc/terms/rights	http://bio2rdf.org/license:drugbank_target.36
http://rdfs.org/void#n:Dataset	http://bio2rdf.org/bio2rdf_dataset:bio2rdf-drugbank-20121008
http://www.w3.org/1999/02/22-rdf-syntax#type	http://bio2rdf.org/drugbank_vocabulary:Target

Taxa in Bio2RDF

- The semantic web is a success
- Why is evolution a problem?
- Addressing evolution

man[taxon:9606] at Bio2RDF

Links Namespace

Find links in namespace

[Find intranamespace links](#)
[Find global links](#)

human[taxon:9606]

taxon:9606

man[taxon:9606]

Homo sapiens Linnaeus, 1758[taxon:9606]

taxon [taxon:9606]

Homo sapiens[taxon:9606]

Subject	Predicate	Object
http://bio2rdf.org/taxon:9606	http://bio2rdf.org/bio2rdf_resource:urlList	http://bio2rdf.org/html/taxon:9606
	http://bio2rdf.org/taxon_vocabulary:division	http://bio2rdf.org/taxon_resource:49afa3da97fca50e0f2464bb6af7b8f
	http://bio2rdf.org/taxon_vocabulary:embl_code	species
	http://bio2rdf.org/taxon_vocabulary:genbank_hidden_flag	1
	http://bio2rdf.org/taxon_vocabulary:genetic_code	http://bio2rdf.org/taxon_resource:c0b482c3147c6fth2bc887e69238e244
	http://bio2rdf.org/taxon_vocabulary:hidden_st_root_flag	0
	http://bio2rdf.org/taxon_vocabulary:inherited_division_flag	1
	http://bio2rdf.org/taxon_vocabulary:inherited_gc_flag	1
	http://bio2rdf.org/taxon_vocabulary:inherited_mgc_flag	1
	http://bio2rdf.org/taxon_vocabulary:mitochondrial_genetic_code_id	2
	http://bio2rdf.org/taxon_vocabulary:name_class	authority common name

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Virtuoso SPARQL Query Editor

Default Data Set Name (Graph IRI)

[About](#) | [Namespace Prefixes](#) | [Inference rules](#) | [SPARQL](#)

Query Text

```
SELECT ?name ?target WHERE {
  ?drug <http://bio2rdf.org/drugbank_vocabulary:target> ?target.
  ?target <http://bio2rdf.org/drugbank_vocabulary:species> <http://bio2rdf.org/taxon:9606>.
  ?target <http://bio2rdf.org/drugbank_vocabulary:xref> <http://bio2rdf.org/uniprot:P06213>.
  ?drug rdfs:label ?name
}
```

(Security restrictions of this server do not allow you to retrieve remote RDF data, see [details](#).)

Results Format:

Execution timeout: milliseconds (values less than 1000 are ignored)

Options: ☒ Strict checking of void variables

(The result can only be sent back to browser, not saved on the server, see [details](#))

[Consult the Virtuoso SPARQL Query Editor](#)

name	target
drug-target interaction Insulin Lispro and Insulin receptor [drugbank_resource:DB00046_36]	http://bio2rdf.org/drugbank_target:36
"Insulin Glargine [drugbank:DB00047]"@en	http://bio2rdf.org/drugbank_target:36
"Insulin, porcine [drugbank:DB00071]"@en	http://bio2rdf.org/drugbank_target:36
"Insulin recombinant [drugbank:DB00030]"@en	http://bio2rdf.org/drugbank_target:36
drug-target interaction Insulin recombinant and Insulin receptor [drugbank_resource:DB00030_36]	http://bio2rdf.org/drugbank_target:36
"Insulin Lispro [drugbank:DB00046]"@en	http://bio2rdf.org/drugbank_target:36
"Insulin Aspart [drugbank:DB01306]"@en	http://bio2rdf.org/drugbank_target:36
"Insulin Glulisine [drugbank:DB01309]"@en	http://bio2rdf.org/drugbank_target:36
drug-target interaction Insulin Glargine and Insulin receptor [drugbank_resource:DB00047_36]	http://bio2rdf.org/drugbank_target:36
"Insulin Detemir [drugbank:DB01307]"@en	http://bio2rdf.org/drugbank_target:36
drug-target interaction Insulin, porcine and Insulin receptor [drugbank_resource:DB00071_36]	http://bio2rdf.org/drugbank_target:36
"Mecasermin [drugbank:DB01277]"@en	http://bio2rdf.org/drugbank_target:36
drug-target interaction Mecasermin and Insulin receptor [drugbank_resource:DB01277_36]	http://bio2rdf.org/drugbank_target:36

Bio2RDF Resources

GitHub This repository Search or type a command

Explore Features Enterprise Blog

PUBLIC **bio2rdf / bio2rdf-scripts** 30 16

Home Pages History

Home

Bio2RDF is an [open-source project](#) that uses Semantic Web technologies to build and provide the largest network of [Linked Data](#) for the Life Sciences. Bio2RDF defines a set of [simple conventions](#) to create RDF(S) compatible Linked Data from a diverse set of heterogeneously formatted sources obtained from multiple data providers.

Bio2RDF Release 2 (Jan 2013) Features:

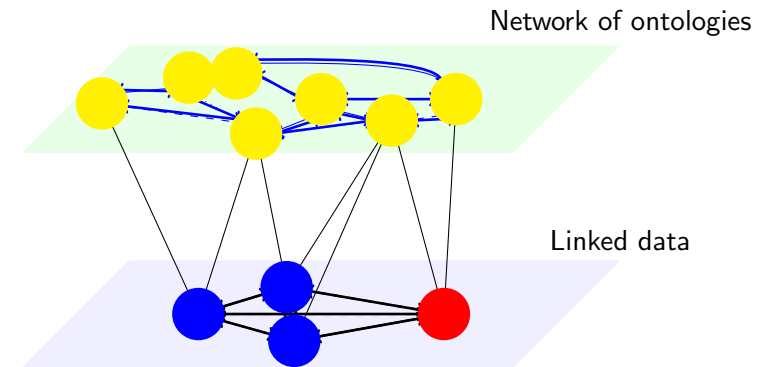
- 1 billion triples across [19 updated datasets](#)
- [updated, MIT licensed scripts](#) available for any use (including commercial use), modification and redistribution.
- IRI normalization through a common dataset registry
- [dataset provenance](#) to inform a user of what version of data they are using and how it was generated.
- [dataset statistics](#) to describe intra and inter dataset connectivity.
- [public CORS-enabled SPARQL 1.1 endpoints](#) for faceted search and federated SPARQL queries
- [downloadable content](#) RDF files and full text-indexed Virtuoso triple stores

Bio2RDF Resources:

404



- ▶ The web relies on a robust design: links can break (404), but Human can cope.
- ▶ Nowadays... it is not clear that this is true anymore (think API changes). Quite some web site do not fail safely.
- ▶ With the semantic web, made for machine, the problem worsen (404 in your city... they call it a traffic jam).



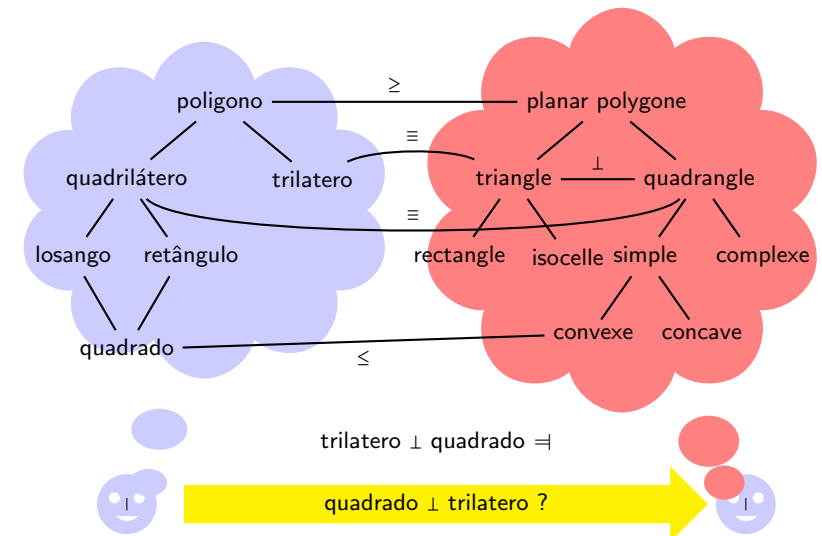
- ▶ From ontology alignments to linked data;
- ▶ From linked data to ontology alignments;
- ▶ More local inference (composition);
- ▶ Reasoning;
- ▶ Repairing, trusting, learning;

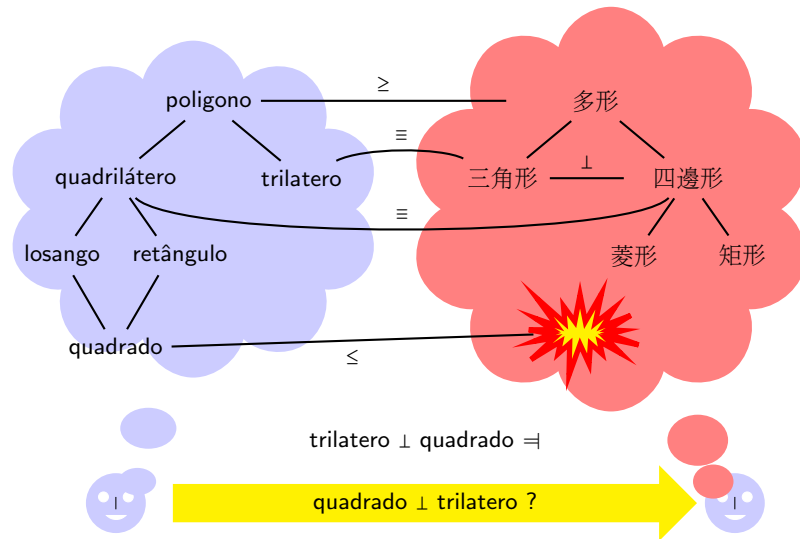
Problems with knowledge: ways it could break

- ▶ incorrect property in data;
- ▶ incorrect subclass relation in ontology;
- ▶ incorrect membership assertion between instance and class;
- ▶ incorrect sameAs link between data;
- ▶ incorrect correspondence in alignments;
- ▶ ...

Hence, the question is not if it will break, but what to do then.
Remember all this is decentralised and distributed.

Knowledge interpretation





Define a communication protocol

Define a message format

← Implement the protocol

Implement the protocol →

It works



§ & % \$!



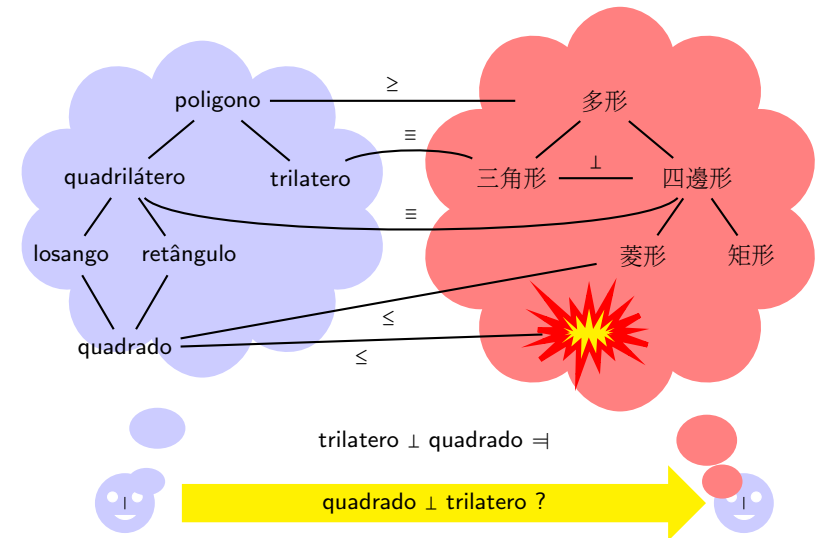
We have lost adaptation capabilities

- ▶ Freeze everything
- ▶ Track everything (ensure that everything is correct beforehand)
- ▶ Let things fail and repair them

- ▶ Preserving decentralisation, distribution and diversity
- ▶ Accepting changes
- ▶ i.e., Breaking with the engineering approach
- ▶ Taking inspiration from how societies evolve

From the ontology matching standpoint:

- ▶ Going from “Match first, then communicate”
- ▶ To: “Try to communicate, and if it breaks match”



Comes from anthropology (and population genetics)

Applies evolution theory to culture:

- ▶ Culture is an “intellectual artefact”
- ▶ which is transmitted (from generation to generation but not exclusively)
- ▶ which can be subject to selection.

- ▶ Pioneered by Robert Axelrod
- ▶ Applies multi-agent simulation to cultural artifacts
- ▶ Successfully applied to natural language by Luc Steels and colleagues
- ▶ Offers a systematic experimentation framework in which agents play “games”

Combining

Knowledge representation

and

experimental cultural evolution

for continuous knowledge evolution

- ▶ Take alignments as culture (not necessarily ontologies):
- ▶ Have agents try to communicate using available alignments;
- ▶ Let them repair them on the fly.

Knowledge game setting

Environment populated by objects characterised by n dimensions: ■, ▲, □, △, ■, ▲, □, △.

Population n agents with their own representations (ontologies)

Initialisation randomly generated alignments between their representations

Game an agent draws randomly an object and ask to another (randomly selected) agent to which class it belongs. The former agent uses the alignments for determining to which class the entity belongs in his own ontology.

Success the resulting class subsumes the class of the object

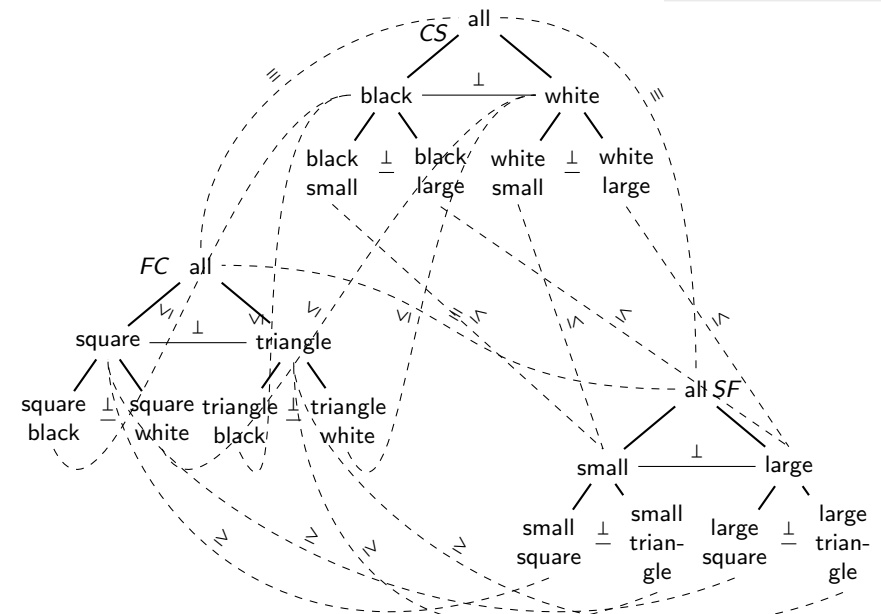
Failure the class is disjoint (exclusive)

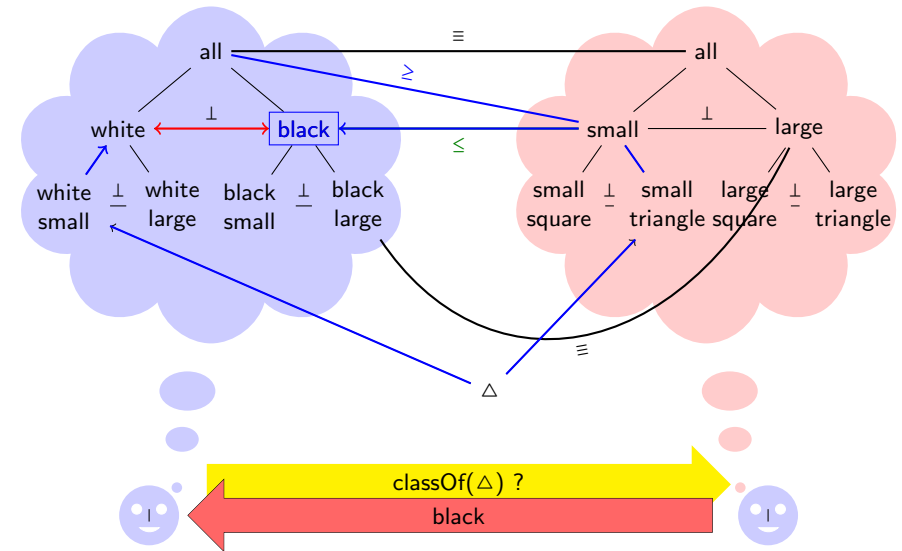
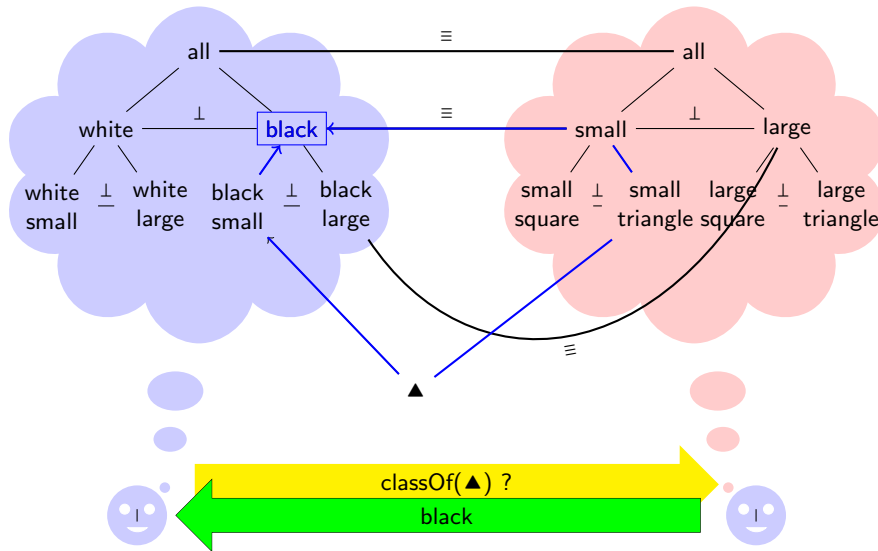
Repair (a) suppress the correspondence; (b) replace it by a weaker correspondences; (c) add an entailed correspondence.

Secondary measure (Semantic) F-measure

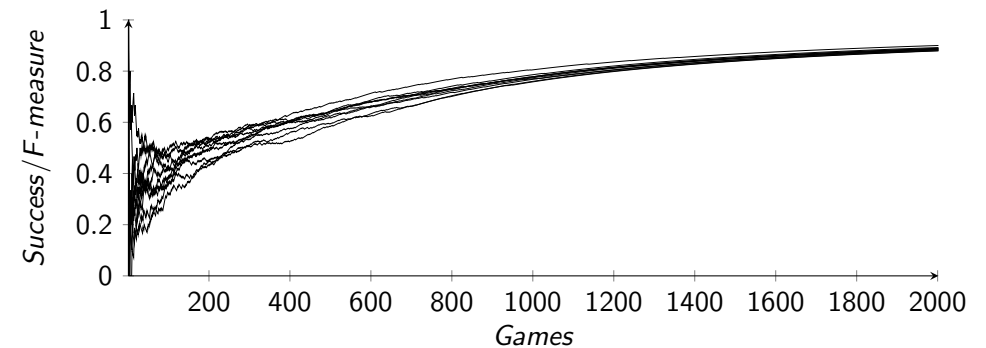
External evaluation Compare to Alcomo, LogMap

Ontology network

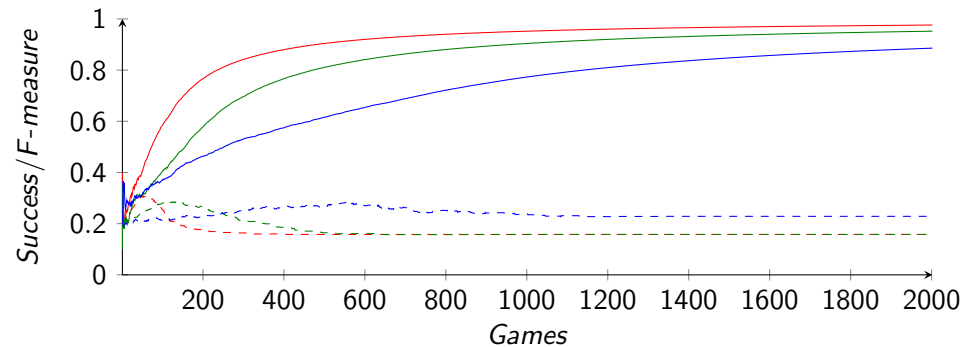




1. Does the process converge?
2. What is the effect of repair modalities?
3. How does this compare to baselines?
4. Does it scale?



modality=add; #agents=4; #games=2000; #runs=1



modality=del,repl,add; #agents=4; #games=2000; #runs=10

del del repl repl add add
success rate F-measure success rate F-measure success rate F-measure

# agents	Incoherence				F-measure				Convergence
	Initial	LogMap	Alcomo	Final	Initial	LogMap	Alcomo	Final	
3	0.31	0.	0.	0.	0.32	0.35	0.36	0.33	300
4	0.47	0.	0.	0.	0.20	0.24	0.25	0.21	1670
5	0.58	0.	0.	0.	0.11	0.18	0.17	0.24	5400
6	0.63	0.	0.	0.	0.06	0.12	0.11	0.14	10.000+

modality=add; #agents=3,4,5,6; #games=10000; #runs=10

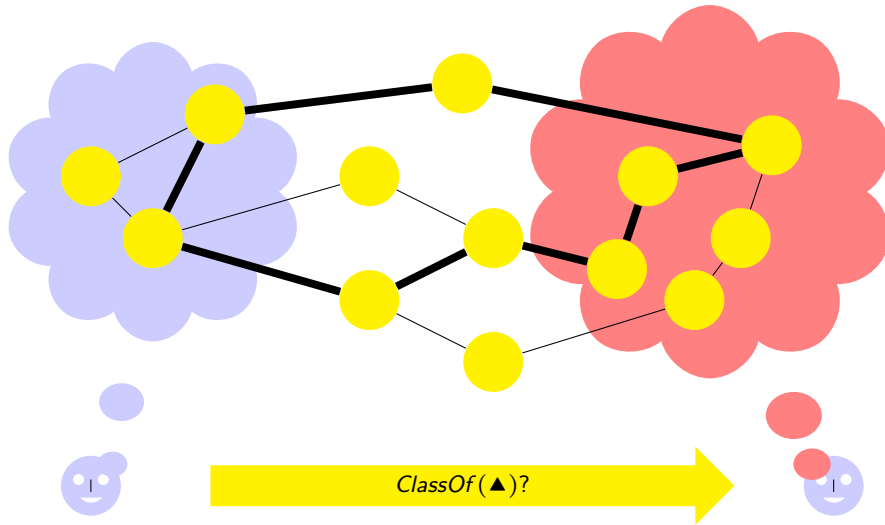
Modality	Size	Success rate	Incoherence degree	Semantic F-measure	Syntactic F-measure	Convergence
reference	70	-	0.0	1.0	1.0	-
initial	54	-	[0.46-0.49]	0.20	(0.20)	-
delete	6	0.98	0.0	0.16	(0.16)	400
replace	6	0.95	0.0	0.16	(0.16)	1000
add	12.7	0.89	0.0	0.23	(0.16)	1330
Alcomo	25.5	-	0.0	0.26	(0.14)	-
LogMap	36.5	-	0.0	0.26	(0.14)	-

modality=del,repl,add; #agents=4; #games=2000; #runs=10

- ▶ The number of games for converging (reaching perfect communication) grows fast (with n);
- ▶ Indeed the probability of finding, at random, the last failure is really low;
- ▶ It is possible to produce an algorithm that converges faster:
- ▶ But this is *not* the problem
- ▶ Their goal is not to solve a problem, but to live
- ▶ How many more do you think it will take you to reach perfect communication with your closest relatives?

Considering agents having each their own network of ontologies

The semantic web is a success
Why is evolution a problem?
Addressing evolution



Wrap-up

The semantic web is a success
Why is evolution a problem?
Addressing evolution

- ▶ The semantic web is a success (and you need it)
- ▶ It can easily break due to the world evolving
- ▶ But the world is evolving (you will not stop that)
- ▶ So our design should be prepared to that
- ▶ Cultural evolution seems an appropriate inspiration

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